GEOKINETICS INC. *shale oil development and production*

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May 9, 1983

Mr. Thomas N. Tetting
Engineering Geologist
Division of Oil Gas and Mining
4241 State Office Building
Salt Lake City, Utah 84114

RE: Process Wastewater Evaporation Pond
Geokinetics Kamp Kerogen
ACT/047/002
Uintah Basin, Utah

Dear Tom:

In response to your questions addressed in your March 31, 1983 letter concerning the design of the process wastewater disposal pond, our Hydrologist, Bill Sharrer, has provided the attached information.

Since I am currently the individual responsible for the Company's environmental affairs, please address all future correspondence through me in our Salt Lake office. I can also be reached by telephone at (801) 583-0511.

I am looking forward to meeting with you so we can discuss an approach to our permitting requirements so we can take our project commercial.

I hope you had a nice vacation.

Sincerely,

Catherine

Catherine V. Chachas
Permit Coordinator

CVC:mw

Encl.

cc: W.K. McOmber
J.M. Lekas
Bill Sharrer

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MAY 11 1983
DIVISION OF
OIL, GAS & MINING

<u>RESPONSE TO QUESTIONS IN REGARD TO THE EVAPORATION POND</u>

1. <u>Sizing Requirements of the Drainage Network</u>

A drainage network of triangular diversion channels has been designed to divert the 10-year, 24-hour storm surface runoff away from the ponds. A schematic diagram of the drainage diversion network is shown on Figure 1, while the calculations for the runoff volumes and peak flows are provided in Appendix A. Sizing requirements were estimated using the SCS "Curve Number" method in conjunction with Manning's equation. The minimum depth of the channel was calculated at 0.6 feet so it can handle the peak flow of 3.96 cfs. An additional 0.3 feet will be added to allow for ample freeboard and thus a greater margin of safety.

2. <u>Abandonment and Reclamation Plans for the Ponds</u>

The estimated 12 month period of use was for the containment of process wastewater produced during the burning of Retorts #27 and #28. It is our intention to also utilize the evaporation ponds during the operation of the Seep Ridge Project, currently under "strength review" by the Synthetic Fuels Corporation. However, since the retort water produced at that time will be converted into steam, the ponds will be used during emergencies only.

Final abandonment and reclamation procedures for the ponds will be included in the revised mine permit application for the Seep Ridge Project, which will be submitted to the Division during the latter part of 1983. A basic reclamation plan has been developed and attached as Appendix B.

3. <u>Lining of the Pond and Leak Detection System</u>

The design plans for Evaporation Pond #1 were submitted to your office in a letter to Mr. Jim Smith from Rusty Lundberg on October 24, 1980. These plans included the liner type, as well as the design of the leak detection system. A copy of that submittal is included with this attachment.

4. <u>Submission of Final Soil Stockpile Protection Plan</u>

A final topsoil stockpile proection plan is described in Appendix C.

5. <u>Fence Design and Construction</u>

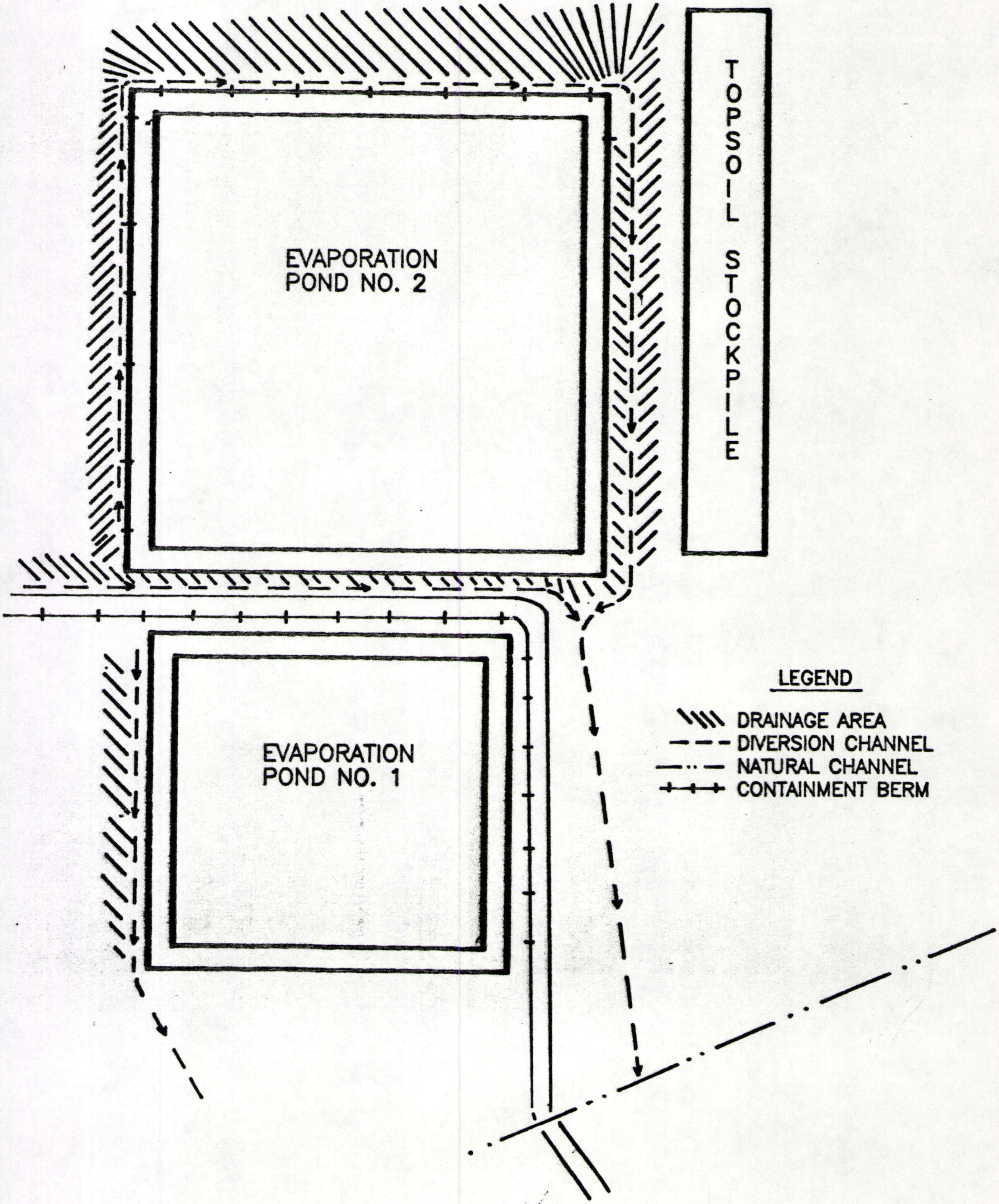
A 5 foot high fence will be placed around the evaporation pond to prevent the access of range livestock. The fence will be constructed of a 4 foot high wire field fence with 1 foot of barbed wire along the top. A similar fence presently surround pond #1.

6. Disturbed Area and Bond Coverage

With the addition of the new pond, the total amount of disturbance at the Kamp Kerogen operation is estimated to be 40 acres. At present, we have posted two bonds with the Division of State Lands for the amount of $30,000. A cost estimate to reclaim the new pond is approximately $25,000. More details on costs are provided in Appendix D.

FIGURE 1

DRAINAGE DIVERSION NETWORK DESIGN



APPENDIX A

DRAINAGE NETWORK DESIGN

Runoff Volume Calculations

Runoff volume and peak flow were estimated for the diversion network given in Figure 1 utilizing the SCS "Curve Number" Method (SCS, 1972). The follwoing parameters were used in the estimate:

Drainage Area (A) = 0.0018 sq. mi.

Diversion Length (L) = 2040 ft.

Average Slope (Y) = 4%

10-year, 24-hour storm = 1.69 in. (NOAA, 1972)

Average Curve Number = 90 (SCS, 1972)

therefore; $S = 1000/CN-10$
$= 1000/90-10$
$= 1.11$

$Q = (P - .2S)^2/P + .8S)$
$= (1.69 - .2(1.11))^2/(1.69 + .8(1.11))$
$= 0.84$ in.

Peak flow for the design storm (1.69 in.) is estimated using the SCS triangular unit hydrograph (SCS, 1972).

Time of concentration (Tc)

$= \text{lag time } (t_L)/0.6$

$t_L = L^{.8}\ (S + 1)^{.7}/1900Y^{.5}$

$= (2040)^{.8}\ (1.11 + 1)^{.7}/1900(4\%)^{.5}$

$= 0.20$ hrs.

thus, $Tc = 0.20/0.6$

$= 0.329$ hrs.

Time of peak (Tp) $= t_L + 0.133\ Tc/2$

$= 0.2 + 0.133(0.329)/2$

$= 0.22$ hrs.

$$\text{Peak flow } (Qp) = 484\ A/Tp$$

$$= 484\ (0.0018)/0.22$$

$$= \underline{\underline{3.96\ \text{cfs}}}$$

Diversion Channel Design

Channel size is estimated using Manning's equation for uniform flow:

$$Q = 1.49\ AR^{.67}\ S^{.5}\ /n$$

For ease of construction and maintenance, a triangular channel with 2:1 sides at 4% slope is used.

A computer program (Croley, 1980) is used for solving the iterative solution of depth (D) (Table 1). According to the program, the minimum depth of the channel should be 0.6 ft. in order to convey the peak flow (3.96 cfs). An additional 0.3 ft. will be added to allow for ample freeboard, thus a greater margin of safety.

TABLE 1

UNIFORM AND CRITICAL FLOW IN PRISMATIC CHANNELS

```
RUN

E - FEET AND SECONDS;

M - METERS AND SECONDS ?  E

    R  - RECTANGULAR;
    T  - TRIANGULAR;
    TR - TRAPEZOIDAL;
    P  - PARABOLIC;
    C  - CIRCULAR ? TR
    SIDE SLOPE (HORIZONTAL/VERTICAL) ? 2
    U  - UNIFORM FLOW; C - CRITICAL FLOW ? U

SOLUTION FOR:

    D - DEPTH;
    Q - FLOW RATE;
    S - SLOPE;
    R - ROUGHNESS COEFFICIENT ? D

        FLOW RATE         ?       3.96
        SLOPE             ?       0.07
      * MANNING'S N       ?       0.029
        DEPTH             =       0.5931 ---- Design Depth
        AREA              =       0.7156
        TOP WIDTH         =       2.3724
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* Barfield et. al, 1983

APPENDIX B

BASIC RECLAMATION PLAN FOR THE EVAPORATION PONDS

Following the design use of the evporation ponds, the disturbed area will be reclaimed so that it is self-draining and non-impounding. All surface and subsurface equipment will be removed, with the liner and evaporative solids transported offsite to an approved disposal facility. The disturbed site will be re-graded close to the original pre-disturbed contour and topsoil distributed proportionally across the area.

The area will be re-seeded using both native and introduced plant species. A preliminary species mix is as follows:

Species	lbs./ac PLS
Bouteloua gracilis	1
Oryzopsis hymenoides	2.5
Agropyron elongatum	4
A. inerme	2
A. smithii	2
Elymus junceus	2
Hedysarum boreale	2
Atriplex canescens	4
Artemisia tridentata	1.5
Ceratoides lanata	3
Chrysothamnus nauseousus	1
	25 lbs PLS

Prior to seeding, the soil will be shallow ripped and harrowed to provide an adequate seedbed for establishing the various selected species. The soil will be chemically and physically analyzed to provide a basis for the application of soil fertility amendments. Should the soil require amendments, such will be applied during the harrowing operation. Seeding techniques will consist of drilling and broadcast applications. The area will be monitored periodically, using acceptable methods, to determine revegetation success. The results of the monitoring will be presented to the division.

APPENDIX C

TOPSOIL STOCKPILE PROTECTION PLAN

In order to adequately protect the stored topsoil, measures will be employed to limit the effects of overland flow as well as erosion of the stockpile surface. These measures will include: (1) the use of diversion channels for conveying surface runoff away from the pile; (2) constructing sediment containment berms along the peripheral of the pile; (3) mulching with straw, and seeding with a temporary plant cover; and (4) limiting the side slopes of the pile, as well as overall depth of the pile. A typical stockpile cross section is given in Figure 2 .

The planned seed mix along with the seeding rate will be as follows:

Species	lbs./ac. PLS
Agropyron dasystachum	10
A. elongatum	10
Lolium multiflorum	20
Melilotus alba	5

The stockpile surface will be roughened to hold surface runoff as well as provide moisture for the seeded cover. Seeding will take place during the late spring provided that soil moisture conditions are adequate. Otherwise, the surface will be mulched for protection during the summer and the stockpile seeded in the late fall.

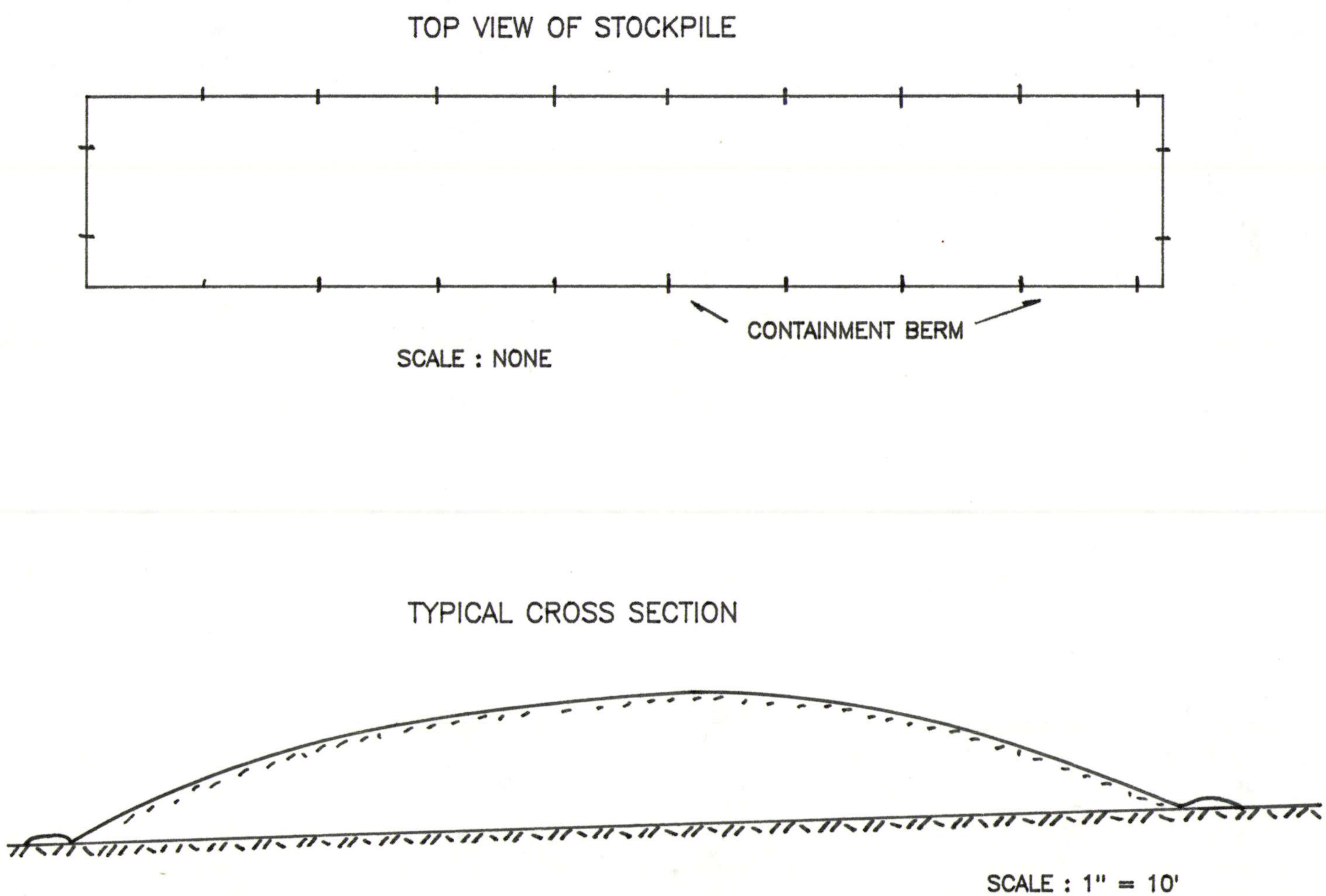

FIGURE 2. TOPSOIL STOCKPILE DESIGN

APPENDIX D

OPERATION	ACRES	COST/ACRE	TOTAL
A. Pond equipment removal			
1. Fencing	3	70	210
2. Liner and solids	3	1,100	3,300
3. Leak detection system	3	250	750
B. Regrading and recontouring			
*1. Earthwork to final grade	4	3,000	12,000
*2. Topsoil respreading	4	1,250	5,000
3. Reseeding	4	150	600
4. Fertilization	4	50	200
5. Mulching	4	30	120
B. Periodic Monitoring	4	700	2,800
TOTAL			$24,980 (1983 $)

* Estimated cost from previous earthwork conducted on-site by various contractors.

REFERENCES

Barfield, B.J., R.C. Warner and C.T. Haan. 1983. Applied Hydrology and Sedimentology for Disturbed Areas. Oklahoma Technical Press, Stillwater, Oklahoma.

Croley, T.E. 1980. Hydrologic and Hydraulic Calculation In Basic For Small Computers.

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Soil Conservation Service, 1972. "Hydrology" Section 4, Soil Conservation Service National Engineering Handbook, U.S. Department of Agriculture, Washington, D.C.